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Graf et al.

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(54) **TISSUE REPAIR ASSEMBLY**

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A61F 2/08 (2006.01)

(52) **U.S. Cl.**
CPC ***A61F 2/0811*** (2013.01); *A61F 2002/0823* (2013.01); *A61F 2002/0829* (2013.01); *A61F 2002/0841* (2013.01); *A61F 2002/0852* (2013.01); *A61F 2002/0858* (2013.01); *A61F 2002/0888* (2013.01)

(58) **Field of Classification Search**
CPC A61F 2/0811; A61F 2002/0823; A61F 2002/0829
USPC 606/310, 321, 323, 328
See application file for complete search history.

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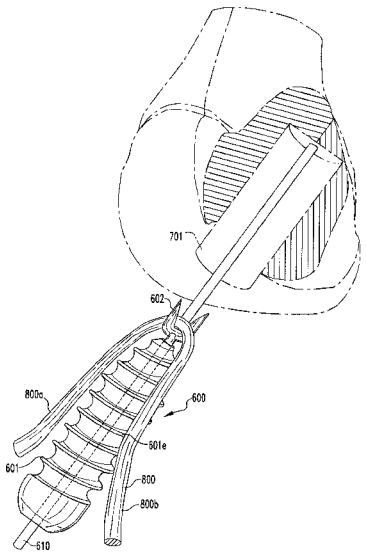
(57) **ABSTRACT**

The present disclosure relates to a tissue repair assembly. The assembly includes an interference device and a fixation device coupled to the interference device, wherein the fixation device includes a coupling portion and a capturing portion. Other assemblies and methods are also disclosed.

13 Claims, 15 Drawing Sheets



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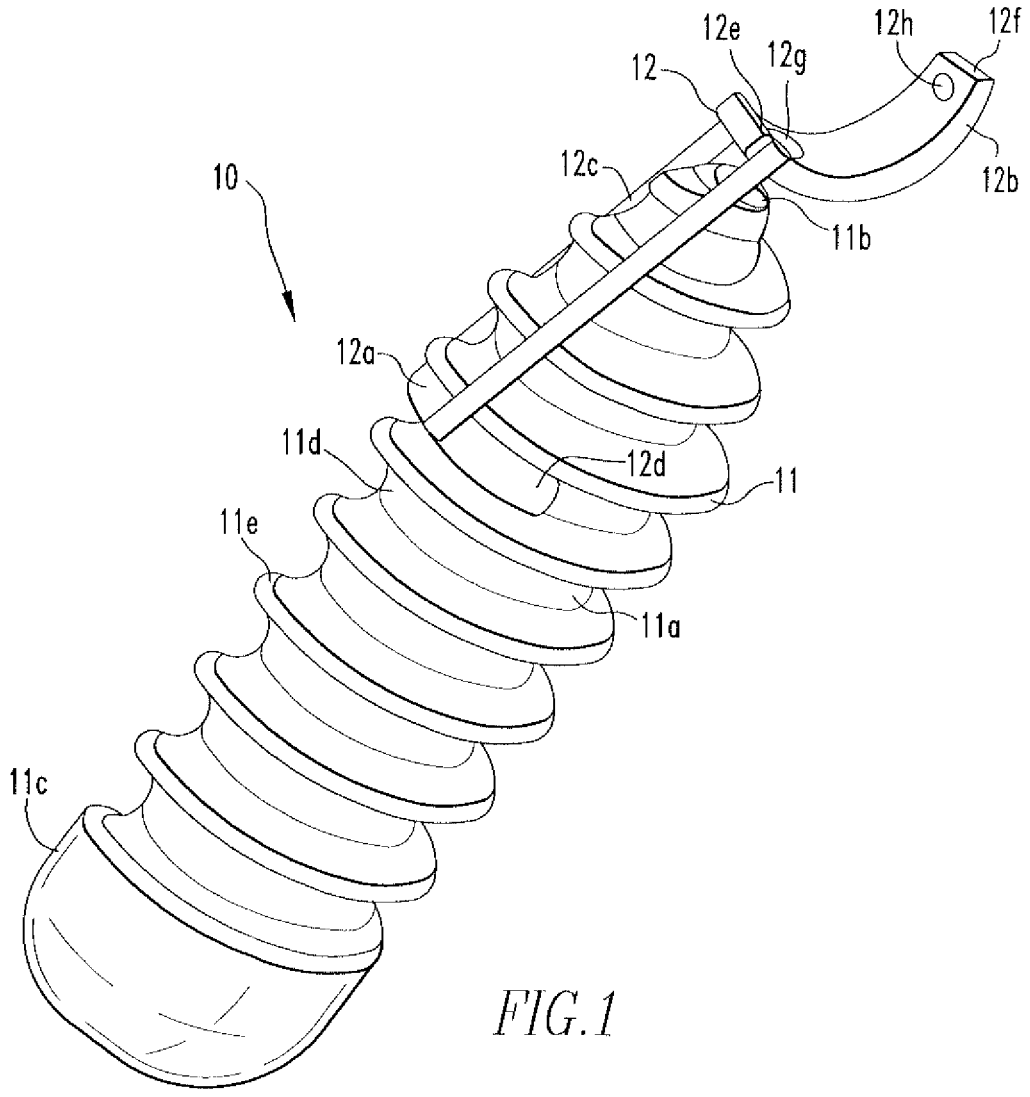


FIG. 1

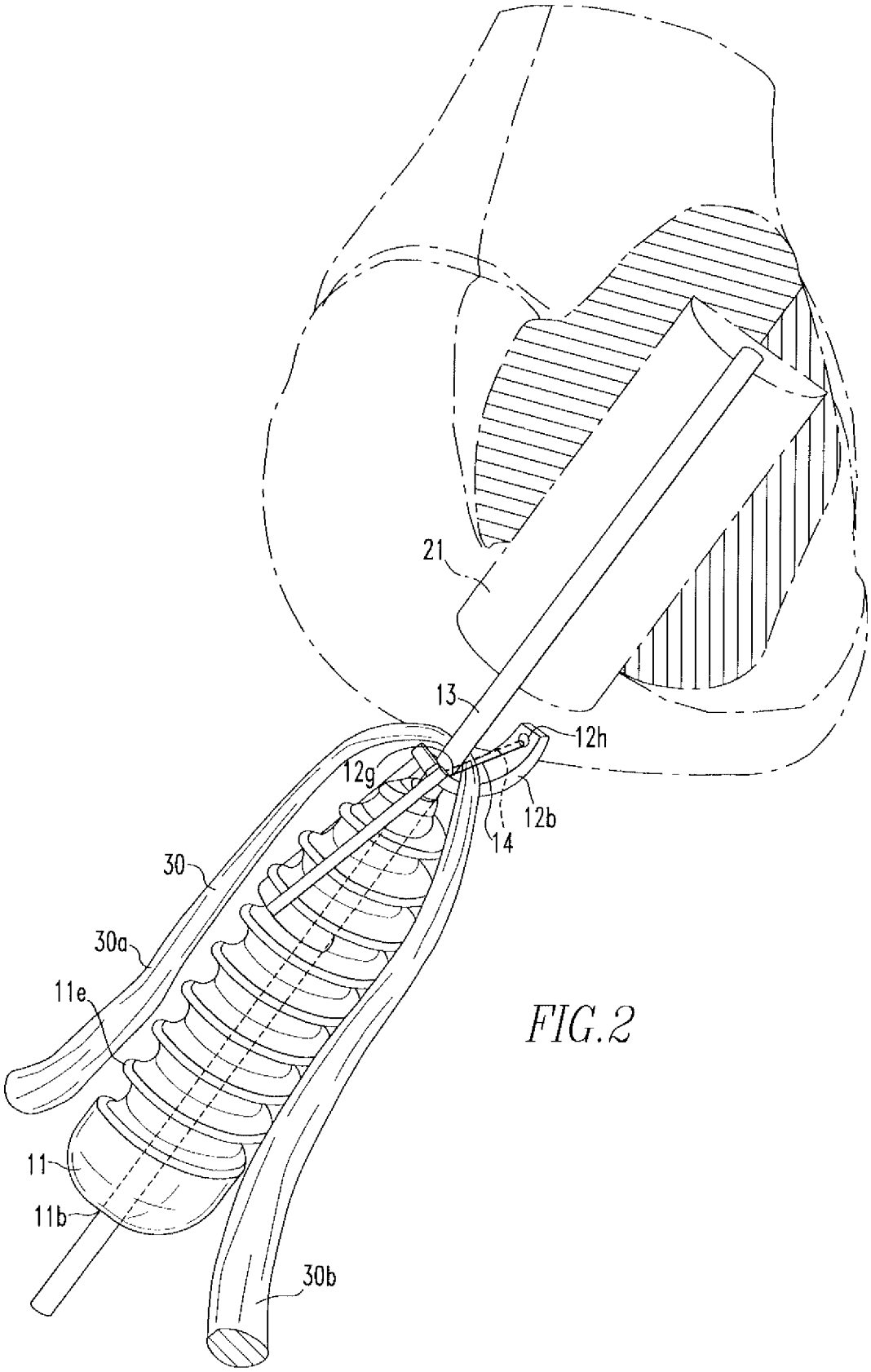


FIG.2

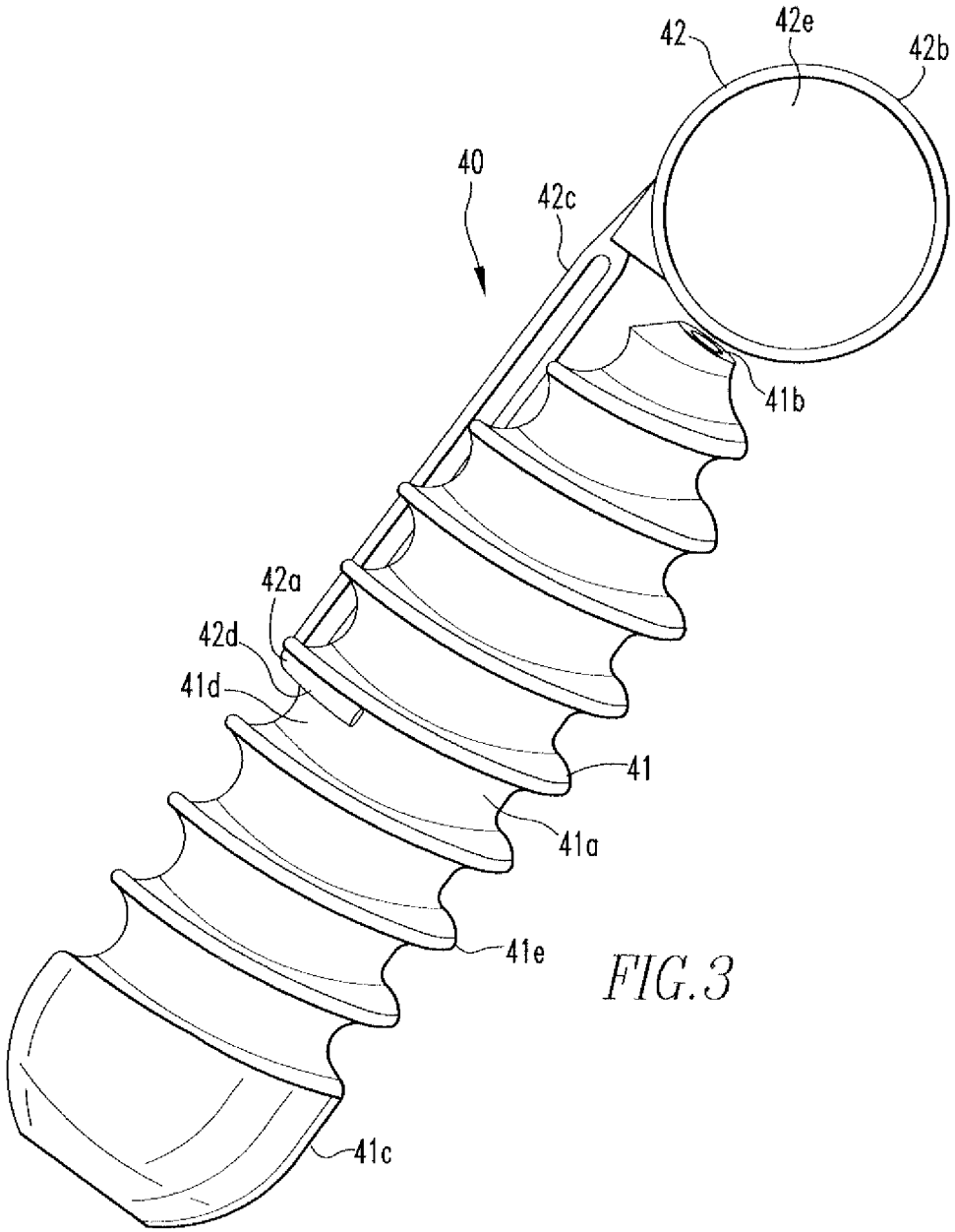


FIG. 3

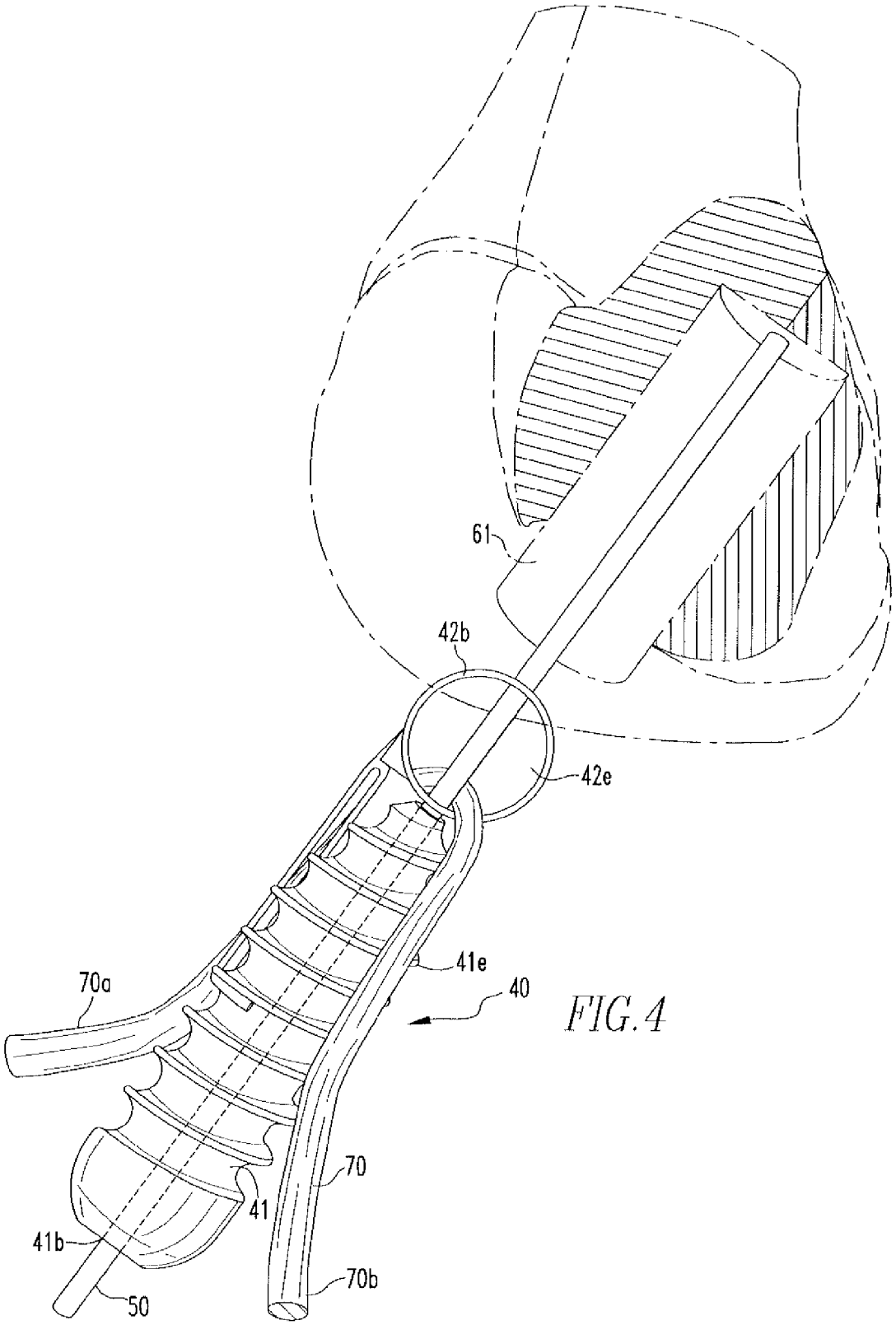
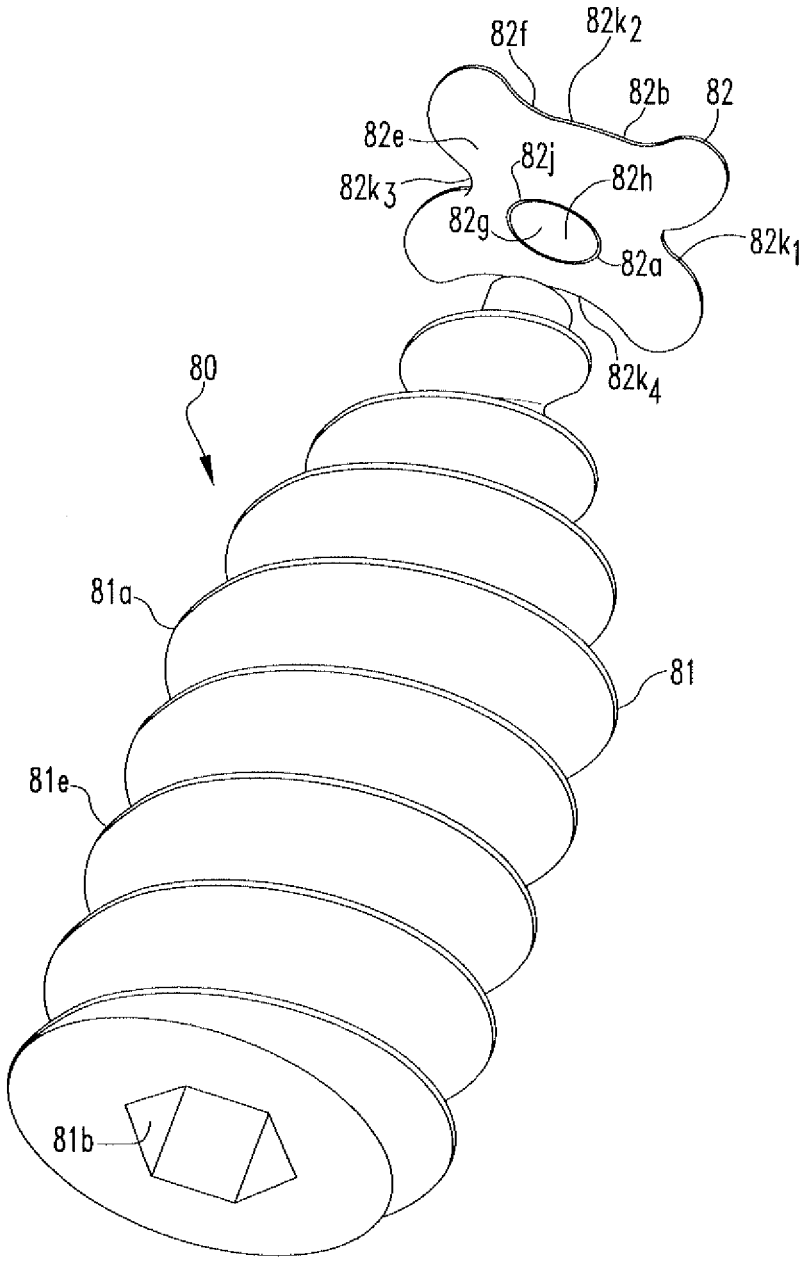


FIG. 4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81b

FIG.5

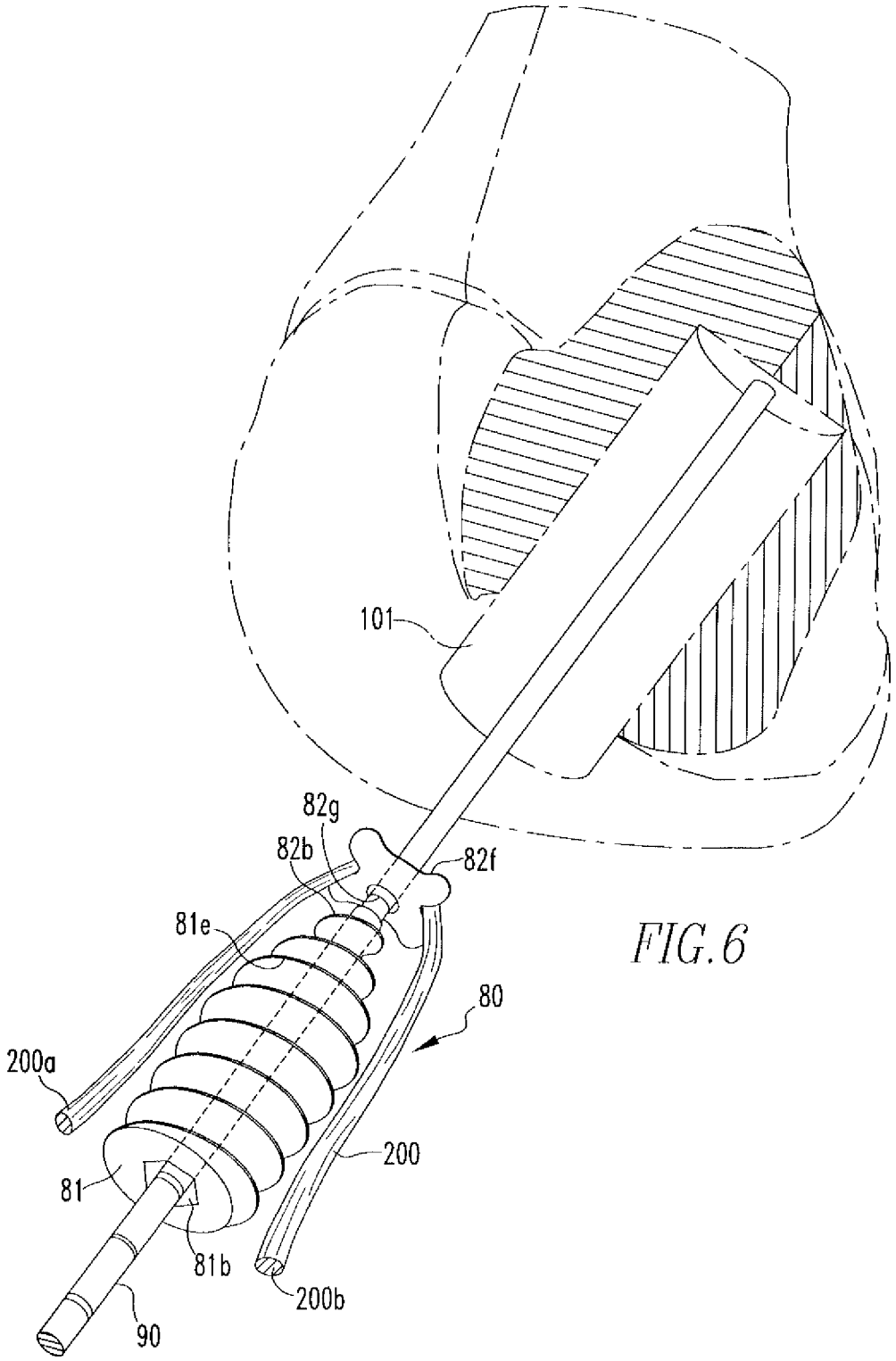


FIG. 6

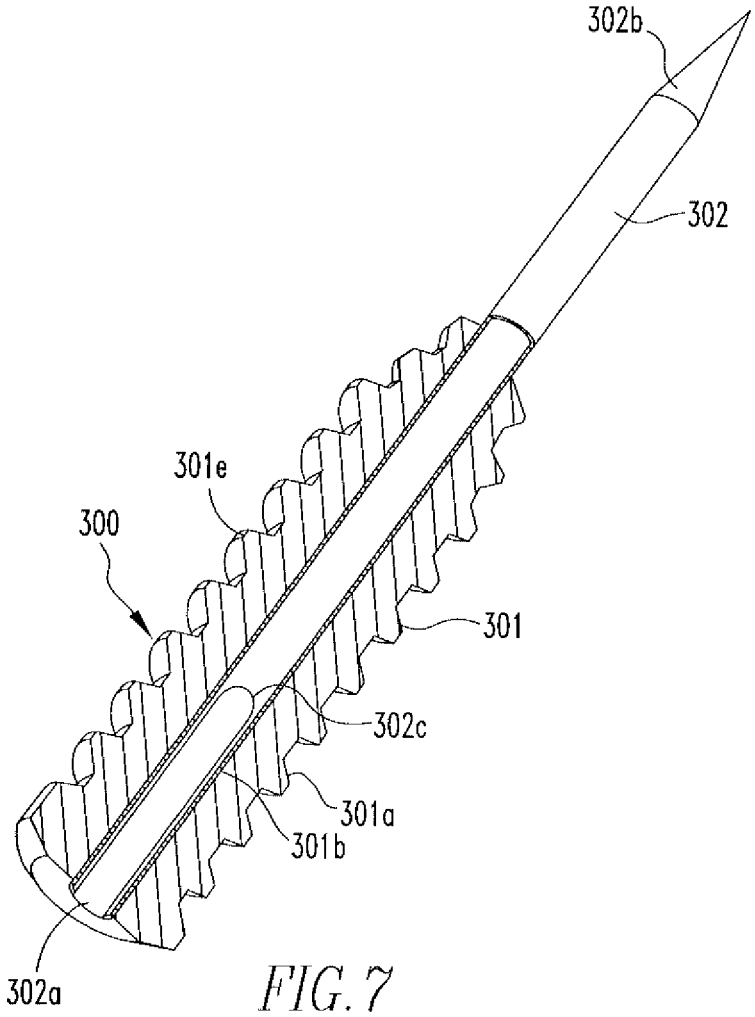


FIG. 7

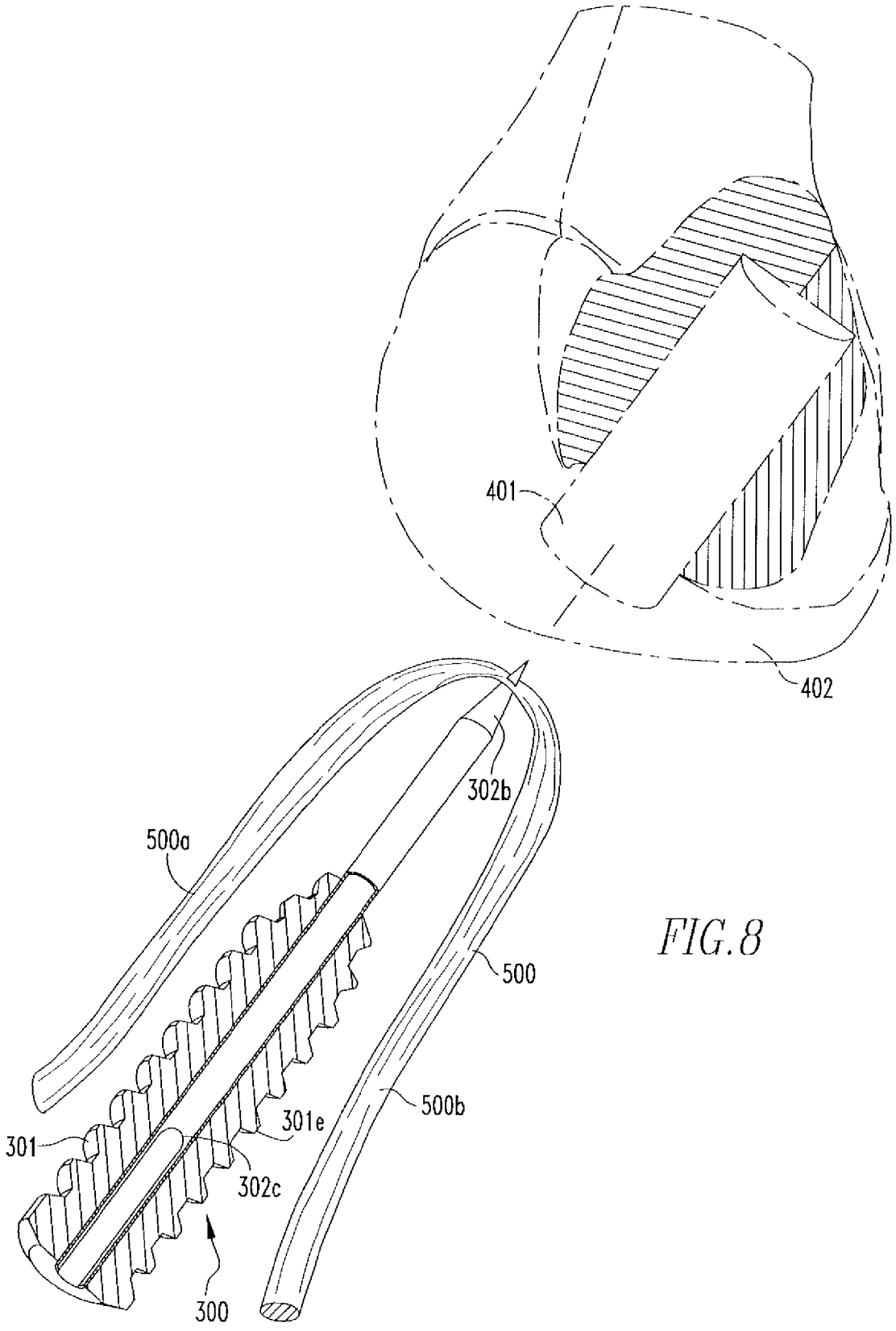


FIG.8

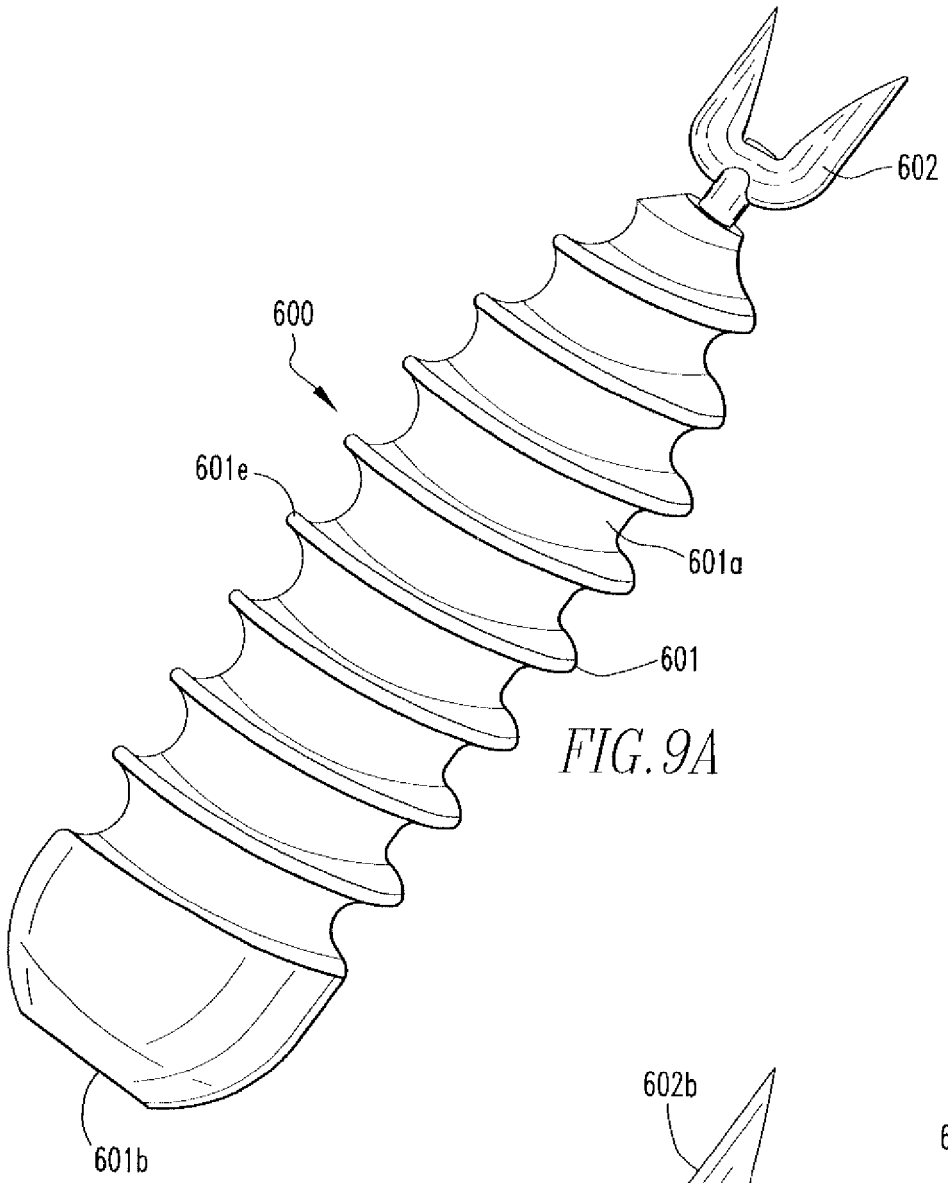


FIG. 9A

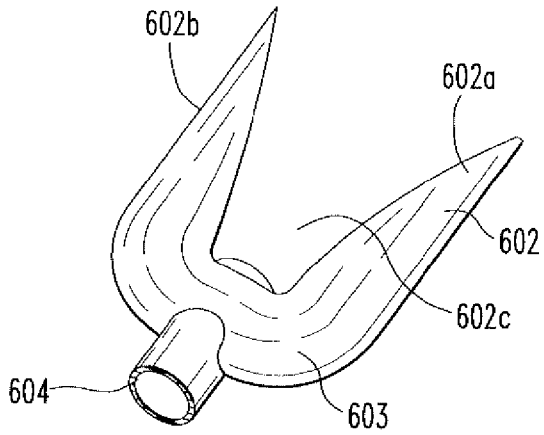


FIG. 9B

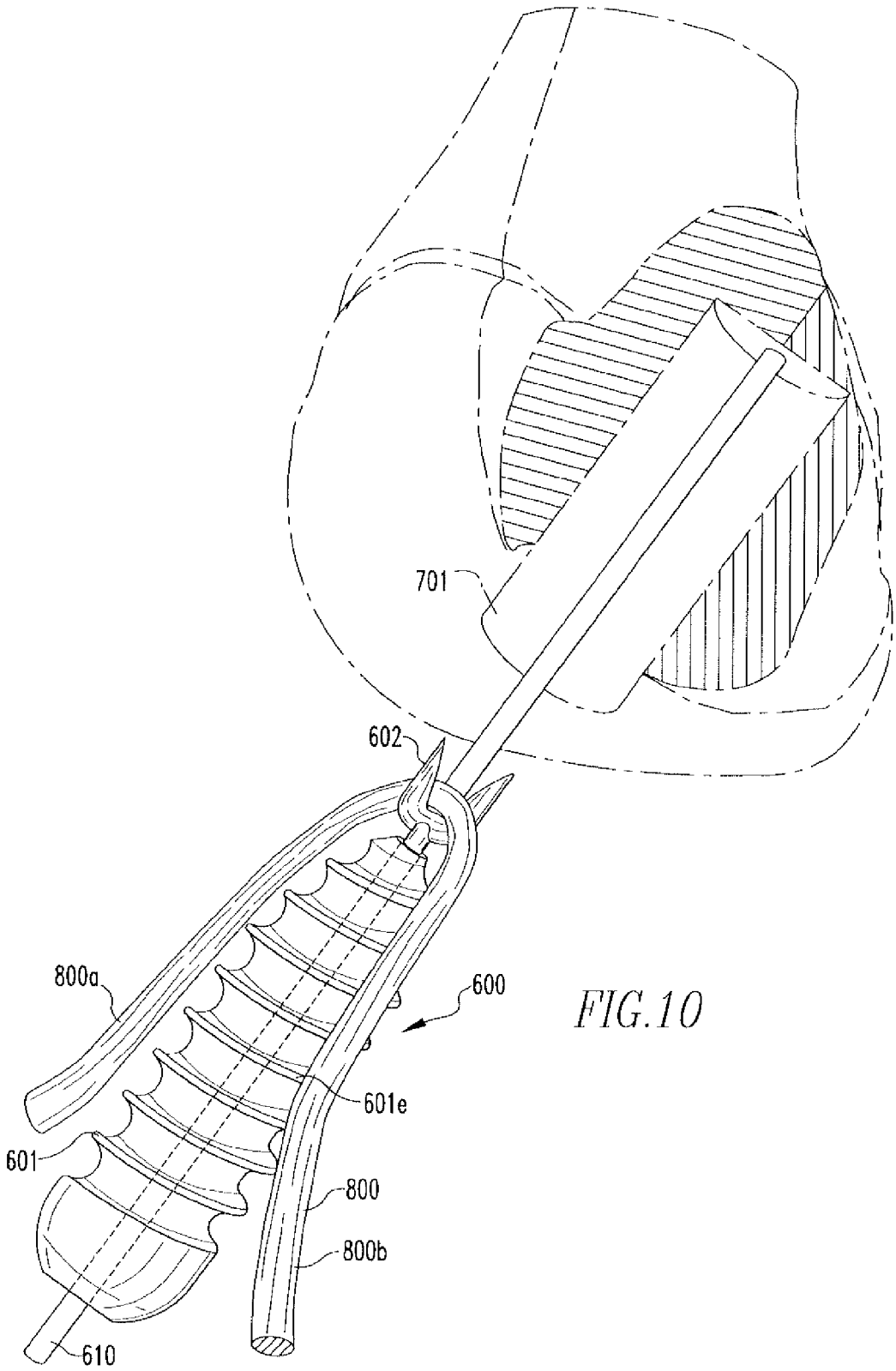


FIG. 10

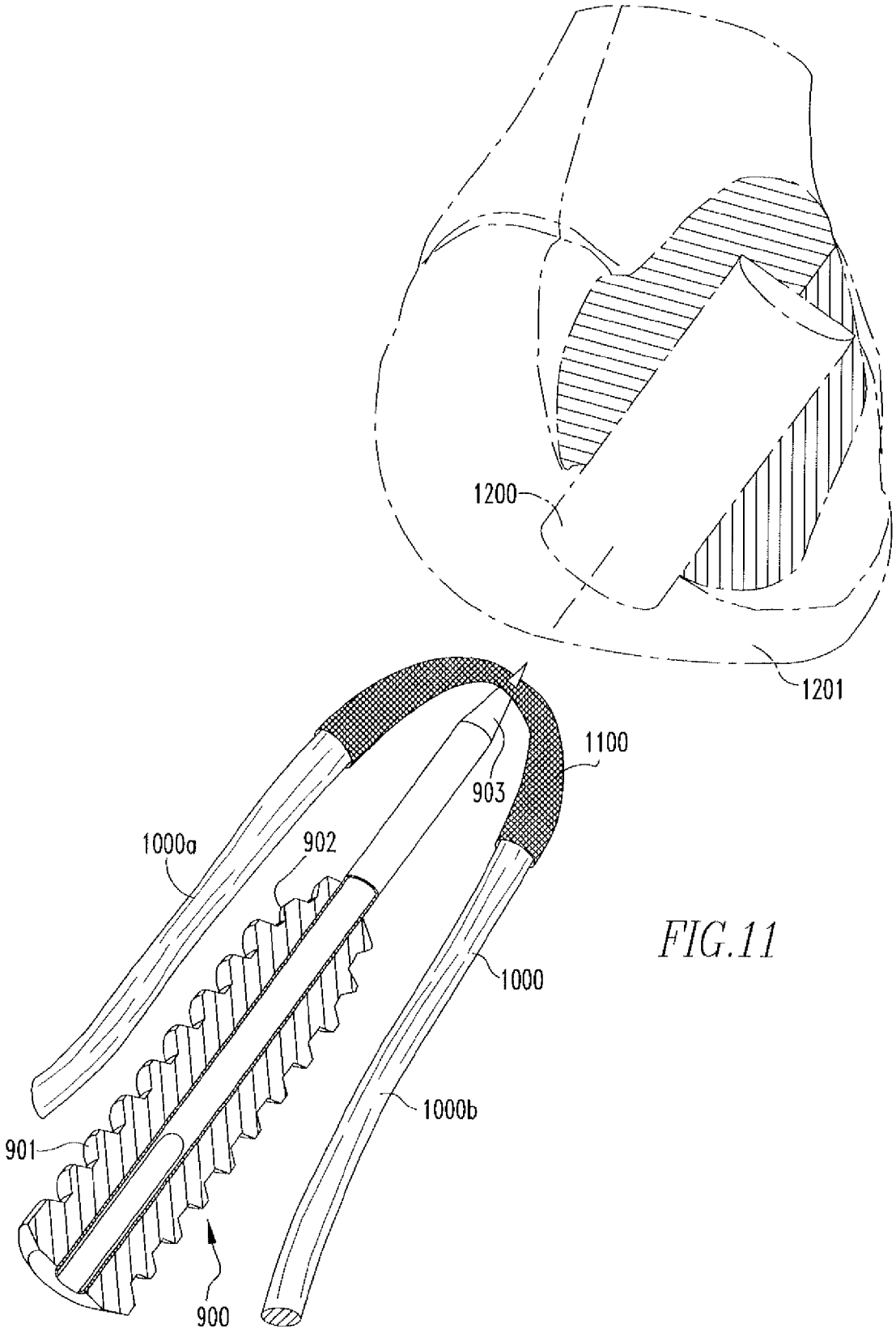


FIG.11

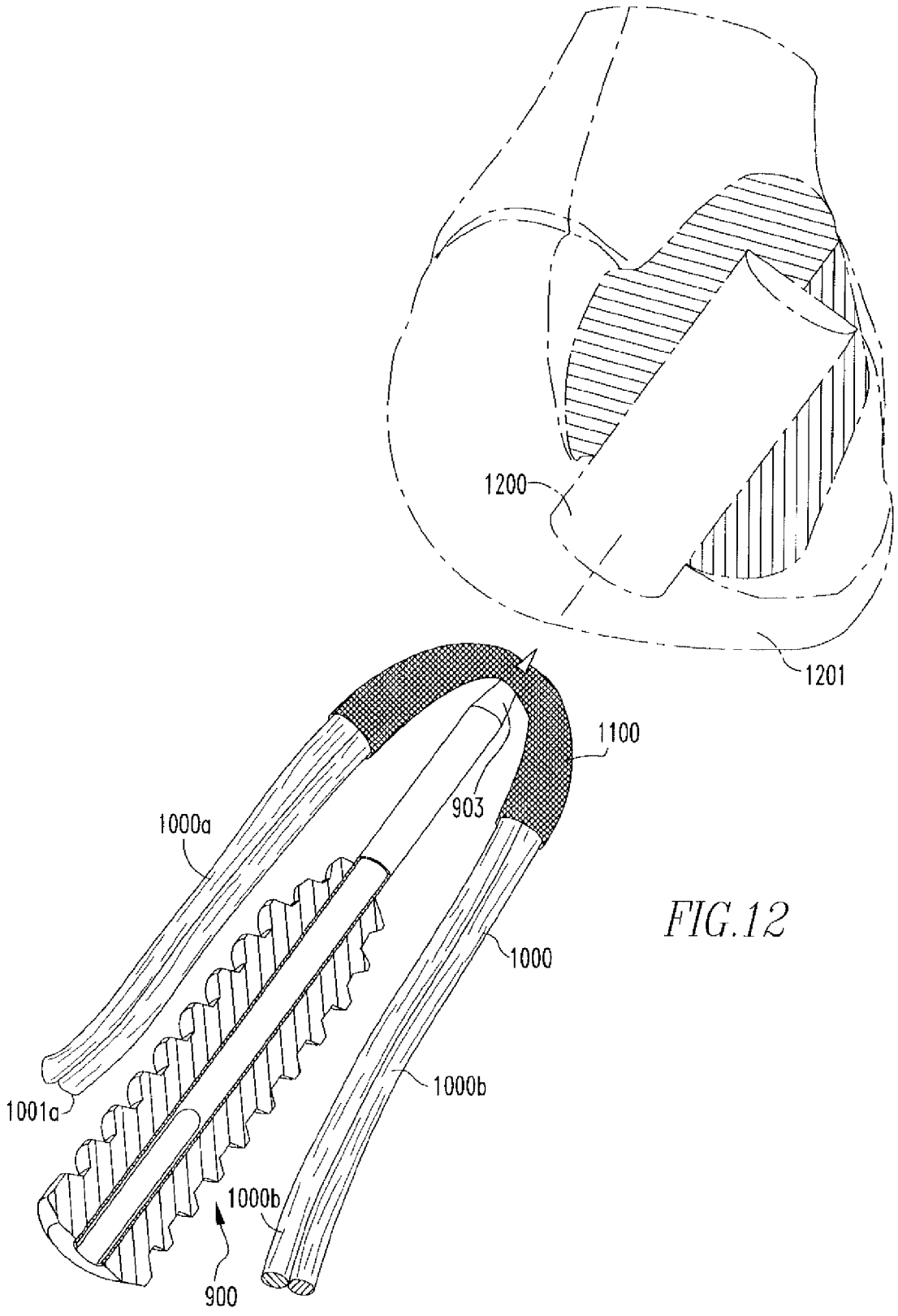


FIG.12

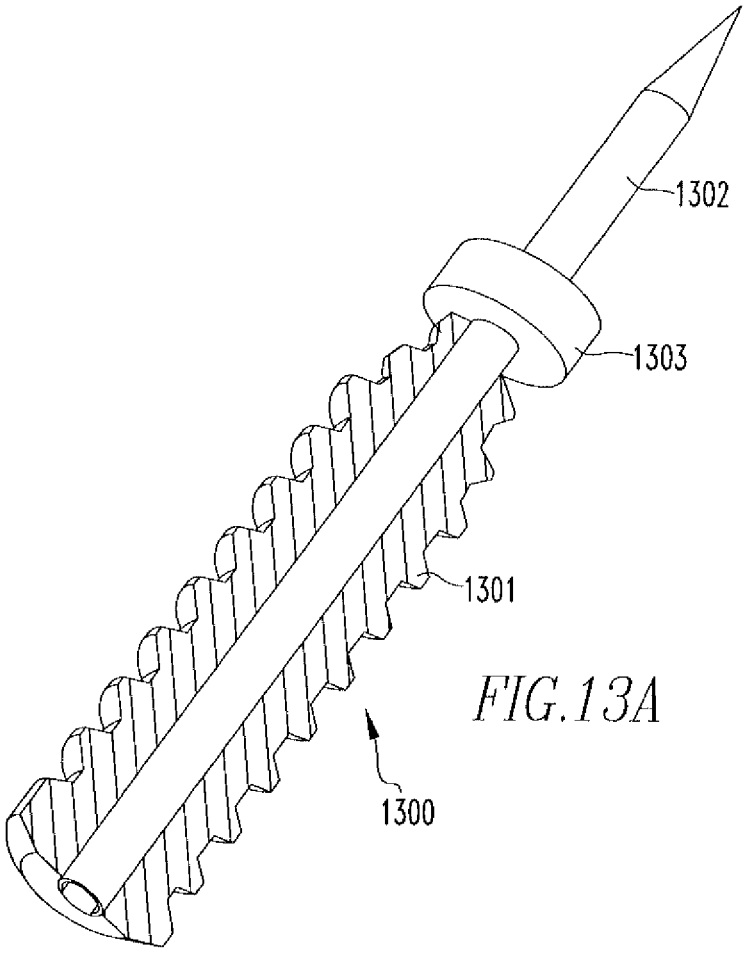


FIG.13A

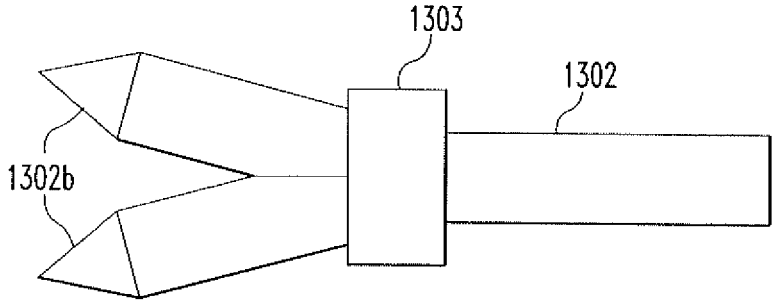
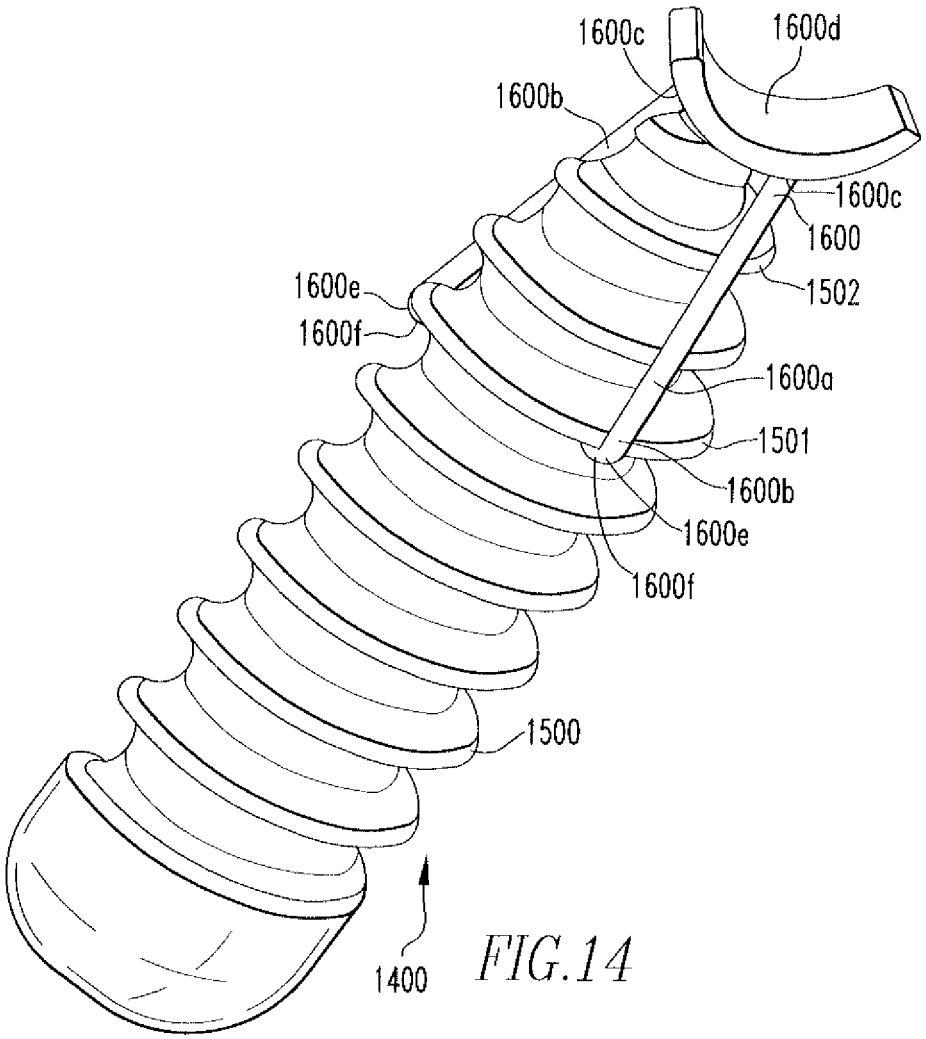


FIG.13B


1600c
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1600f
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1400

FIG.14

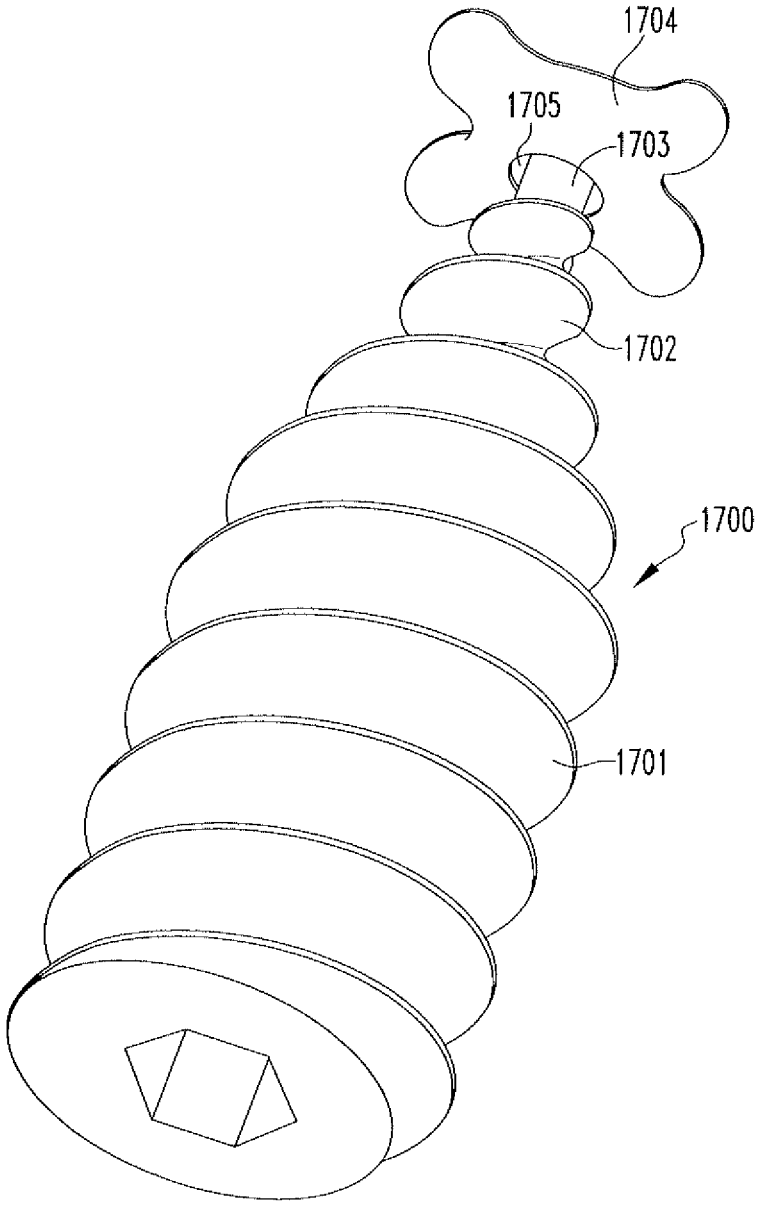

FIG.15

TISSUE REPAIR ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of U.S. Ser. No. 12/631,960 filed Dec. 7, 2009, which is currently pending, which claims the benefit of U.S. Patent Application Ser. No. 61/120,898 filed on Dec. 9, 2008, the disclosures of which are incorporated herein by reference in their entirety.

BACKGROUND

1. Field of Technology

The present disclosure relates generally to soft tissue repair, and more specifically, devices and methods used for such repair.

2. Related Art

Current devices available for arthroscopic soft tissue repair include suture anchors, metal post and washer screws, and interference screws. These devices provide immediate fixation of the tissue to the bone with little postoperative activity modification. However, the tissue must be delivered out of the body, stitched, and then re-inserted into a previously drilled bone hole. This reinsertion can be done through a portal, but is very technically demanding, precluding some patients from being a candidate for this procedure. Additionally, these devices don't prevent the tissue from sliding past the device as the device is inserted into the bone hole and/or when repetitive loads are applied to the soft tissue after fixation. Slippage of the tissue past the device may lead to decreased or failed fixation of the tissue to the bone and therefore an unsuccessful repair.

Therefore, a procedure is needed that is simple, reproducible, and that would allow both beginner and experienced surgeons to perform the procedure. Similarly, the devices used in the procedure would be simple to use, cost effective, and marketable to arthroscopic and open surgery surgeons alike and configured to prevent the tissue from sliding past the devices.

SUMMARY

In one aspect, the present disclosure relates to a tissue repair assembly. The assembly includes an interference device and a fixation device coupled to the interference device, wherein the fixation device includes a coupling portion and a capturing portion. In an embodiment, the interference device includes threads on an outer surface of the interference device. In another embodiment, the capturing portion includes a semi-circular shape. In yet another embodiment, the capturing portion includes a first end having a hole and a second end having a hole. In a further embodiment, the interference device includes a cannulation. In yet a further embodiment, the capturing portion is a loop and includes a through hole. In an embodiment, the capturing portion includes a top surface, a bottom surface, and at least two grooves. In another embodiment, the capturing portion includes a through hole having a first opening on the top surface and a second opening on the bottom surface. In yet another embodiment, the capturing portion includes an opening and the interference device includes a tip, the tip extending through the opening. In a further embodiment, the first opening includes a rim surrounding the first opening. In yet a further embodiment, the capturing portion includes four grooves.

In an embodiment, the interference device is configured for engagement with soft tissue. In another embodiment, the fixation device is configured for engagement with soft tissue. In yet another embodiment, the fixation device is configured for engagement with the bone. In a further embodiment, the capturing device is open-ended. In yet a further embodiment, the capturing device is closed-ended. In an embodiment, the fixation device includes a shape memory material. In another embodiment, the coupling portion includes at least two legs. In yet another embodiment, each leg includes two ends, wherein one end is coupled to the capturing portion and the other end is coupled to the interference device. In a further embodiment, the coupling portion is coupled to the interference device via a snap-fit connection.

In another aspect, the present disclosure relates to a tissue repair assembly. The assembly includes an interference device and a fixation device coupled to the interference device, wherein the fixation device includes a proximal end and a pointed distal end. In an embodiment, the fixation device includes a channel extending a partial length of the fixation device. In another embodiment, the interference device includes a cannulation, wherein the fixation device is partially housed within the cannulation. In yet another embodiment, the fixation device is coupled to the interference device via engagement between surface features on the fixation device and surface features on the interference device. In a further embodiment, the fixation device includes a collar. In yet a further embodiment, the fixation device includes multiple pointed distal ends.

In yet another aspect, the present disclosure relates to a fixation device. The fixation device includes a base portion having a first leg, a second leg, and a groove located between the first and second legs; and a top portion extending from the base portion. In an embodiment, the device is cannulated. In another embodiment, both the first leg and the second leg include a pointed end portion.

In a further aspect, the present disclosure relates to a tissue repair assembly. In an embodiment, the assembly includes a fixation device having a base portion including a first leg, a second leg, and a groove located between the first and second legs, and a top portion extending from the base portion and an interference device coupled to the fixation device. In an embodiment, the fixation device is cannulated. In another embodiment, the interference device is cannulated. In yet another embodiment, the interference device is coupled to the top portion of the fixation device. In yet another embodiment, the interference device includes threads on an outer surface of the interference device. In a further embodiment, the interference device is configured for rotary advancement into a target tissue.

In yet a further aspect, the present disclosure relates to a method of tissue repair. The method includes preparing a hole in a bone; inserting soft tissue into the hole via the use of a fixation device; and inserting an interference device into the hole.

In an embodiment, the fixation device includes a base portion having a first leg, a second leg, and a groove located between the legs, and a top portion extending from the base portion. In another embodiment, the soft tissue is located within the groove of the fixation device when the soft tissue is advanced into the hole. In yet another embodiment, the method further includes applying tension to the soft tissue prior to inserting the interference device into the hole. In a further embodiment, inserting the interference device into the hole fixates the soft tissue to the bone. In yet a further embodiment, the interference device includes threads on an outer surface of the interference device. In an embodiment, the

interference device is configured for rotary advancement into the hole. In another embodiment, insertion of the interference device into the hole occurs via rotary advancement of the interference device into the hole.

In yet another embodiment, the soft tissue includes a sleeve of woven or braided material. In a further embodiment, the fixation device engages the sleeve. In yet a further embodiment, the fixation device engages the sleeve and the soft tissue. In an embodiment, the fixation device engages the sleeve, the soft tissue, and the bone. In another embodiment, the fixation device engages the soft tissue and the bone. In yet another embodiment, the interference device includes a cannulation and the interference device is inserted into the hole such that the interference device is housed within the cannulation. In a further embodiment, the fixation device is coupled to the interference device via engagement between surface features on the fixation device and surface features on the interference device. In yet a further embodiment, the fixation device is coupled to the interference device via engagement between surface features on the fixation device and surface features on the interference device. In an embodiment, the sleeve is coupled to the soft tissue via use of a suture.

In an aspect, the present disclosure relates to a method of tissue repair. The method includes preparing a hole in a bone; inserting a soft tissue into the hole; inserting an interference device into the hole, the interference device including a cannulation; and inserting the fixation device into the hole such that the fixation device is housed within the cannulation. In an embodiment, upon insertion of the fixation device into the hole, the fixation device engages the soft tissue. In another embodiment, the fixation device engages both the soft tissue and the bone.

Further areas of applicability of the present disclosure will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the disclosure, are intended for purposes of illustration only and are not intended to limit the scope of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of the specification, illustrate the embodiments of the present disclosure and together with the written description serve to explain the principles, characteristics, and features of the disclosure. In the drawings:

FIG. **1** shows a perspective view of a first tissue repair assembly of the present disclosure.

FIG. **2** shows a perspective view of the tissue repair assembly of FIG. **1** during soft tissue repair.

FIG. **3** shows a perspective view of a second tissue repair assembly of the present disclosure.

FIG. **4** shows a perspective view of the tissue repair assembly of FIG. **3** during soft tissue repair.

FIG. **5** shows a perspective view a third tissue repair assembly of the present disclosure.

FIG. **6** shows a perspective view of the tissue repair assembly of FIG. **5** during soft tissue repair.

FIG. **7** shows a cross-sectional view of a fourth tissue repair assembly of the present disclosure.

FIG. **8** shows a perspective view of the tissue repair assembly of FIG. **7** during soft tissue repair.

FIG. **9**A shows a perspective view a fifth tissue repair assembly of the present disclosure.

FIG. **9**B shows a perspective view of the fixation device of the tissue repair assembly of FIG. **9**A.

FIG. **10** shows a perspective view of the tissue repair assembly of **9**A during soft tissue repair.

FIG. **11** shows a perspective view of the fourth tissue repair assembly during soft tissue repair wherein the soft tissue includes a sleeve.

FIG. **12** shows a perspective view of the fourth tissue repair assembly during soft tissue repair wherein the soft tissue strands include a sleeve.

FIG. **13**A shows a perspective view of a sixth tissue repair assembly of the present disclosure.

FIG. **13**B shows a perspective view of an alternative fixation device for use in the sixth tissue repair assembly of FIG. **13**A.

FIG. **14** shows a perspective view of a seventh tissue repair assembly of the present disclosure.

FIG. **15** shows a perspective view of an eighth tissue repair assembly of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the disclosure, its application, or uses.

FIG. **1** shows a first tissue repair assembly **10** of the present disclosure. The assembly **10** includes an interference device **11** having a tapered body **11***a* and a cannulation **11***b*. The body **11***a* includes a first portion **11***c* and a second portion **11***d* having threads **11***e*. The assembly **10** also includes a fixation device **12** coupled to the interference device **11**. The fixation device **12** includes a coupling portion **12***a* and a capturing portion **12***b*. The coupling portion **12***a* includes a shaft **12***c* and a coupler **12***d*. The coupler **12***d* includes an open-ended shape, such as a semi-circular shape, and is configured to provide a snap-fit connection to the body **11***a* of the interference device **11**. The capturing portion **12***b* also includes a semi-circular shape and has a first end **12***e* and a second end **12***f*. The first end **12***e* includes a first opening **12***g* and the second end **12***f* includes a second opening **12***h*. The first opening **12***g* is aligned with the cannulation and is configured to house a guide wire, as will be further discussed below, and the second opening **12***h* is configured to house a suture, as will be further described below.

FIG. **2** shows the assembly **10** disposed on a guide wire **13**. The guide wire **13** is advanced into a bone tunnel **21**, such as a tibial tunnel of a knee joint, and the assembly **10** is disposed on the guide wire **13**, such that the guide wire **13** is passed through the first opening **12***g* and the cannulation **11***b*. A soft tissue graft **30** rests on the capturing portion **12***b* with each end **30***a*,**30***b* of the graft **30** draped over the interference device **11**. A suture **14** may be used to further capture the graft **30** on the capturing portion **12***b* by placing ends of the suture **14** through openings **12***g*,**12***h*, such that the suture **14** is placed over the tissue **30**, and then tying the ends of the suture **14**. The assembly **10** and graft **30** are advanced into the bone tunnel **21**, via a delivery device (not shown). The threads **11***e* allow for compression of the graft **30** against the walls of the bone tunnel **21**.

FIG. **3** shows a second tissue repair assembly **40** of the present disclosure. The assembly **40** includes an interference device **41** having a tapered body **41***a* and a cannulation **41***b*. The body **41***a* includes a first portion **41***c* and a second portion **41***d* having threads **41***e*. The assembly **40** also includes a fixation device **42** coupled to the interference device **41**. The fixation device **42** includes a coupling portion **42***a* and a capturing portion **42***b*. The coupling portion **42***a* includes a shaft **42***c* and a coupler **42***d*. The coupler **42***d* includes a

semi-circular shape and is configured to provide a snap-fit connection to the body **41***a* of the interference device **41**. The capturing portion **42***b* is in a closed-ended shape, such as a loop, and includes a through hole **42***e* configured for disposal of a soft tissue graft.

FIG. **4** shows the assembly **40** located on a guide wire **50**. The guide wire **50** is advanced into a bone tunnel **61**, such as a tibial tunnel of a knee joint, and the assembly **40** is disposed on the guide wire **50**, such that the guide wire **50** is passed through the cannulation **41***b*. A soft tissue graft **70** is disposed through the hole **42***e* of the caturing portion **42***b* with each end **70***a*,**70***b* of the graft **70** draped over the interference device **41**. The assembly **40** and graft **70** are advanced into the bone tunnel **61**, via a delivery device (not shown). The threads **41***e* allow for compression of the graft **70** against the walls of the bone tunnel **61**.

FIG. **5** shows a third tissue repair assembly **80** of the present disclosure. The assembly **80** includes an interference device **81** having a tapered body **81***a* having threads **81***e* and a cannulation **81***b*. The assembly **80** also includes a fixation device **82** coupled to the interference device **81**. The fixation device **82** includes a coupling portion **82***a* and a capturing portion **82***b*. The capturing portion **82***b* includes a top surface **82***e*, a bottom surface **82***f*, and a through hole **82***g*. The through hole **82***g* includes a first opening **82***h* located on the top surface **82***e* and a second opening (not shown) located on the bottom surface **82***f*. A rim **82***j* surrounds the first opening **82***h* and serves as the coupling portion **82***a* to couple the fixation device **82** to the interference device **81**. The rim **82***j* includes a diameter equal to an inner diameter of the interference device **81**. For the purposes of this disclosure, the capturing portion **82***b* includes four grooves **82***k*$_1$-**82***k*$_4$. However, the capturing portion **82***b* may have less than four grooves, such as the two grooves **82***k*$_1$,**82***k*$_3$ for housing of end portions of a soft tissue graft, as will be further described below. In addition, it is also within the scope of this disclosure for the rim **82***j* to have a diameter less than or greater than an inner diameter of the interference device **81**.

FIG. **6** shows the assembly **80** located on a guide wire **90**. The guide wire **90** is advanced into a bone tunnel **101**, such as a tibial tunnel of a knee joint, and the assembly **80** is disposed on the guide wire **90**, such that the guide wire **90** is passed through the cannulation **81***b* and the through hole **82***g* of the capturing portion **82***b*. A soft tissue graft **200** rests on the bottom surface **82***f* of the capturing portion **82***b* with each end **200***a*,**200***b* of the graft **200** draped over the interference device **81** and housed in grooves **82***k*$_1$, **82***k*$_3$. The assembly **80** and graft **200** are advanced into the bone tunnel **101**, via a delivery device (not shown). The threads **81***e* allow for compression of the graft **200** against the walls of the bone tunnel **101**.

For the purposes of FIGS. **5** and **6**, it is within the scope of this disclosure for the capturing portion to not have grooves. Rather the sides of the capturing portion may be straight such that the portion is in the shape of a square. Other shapes are also within the scope of this disclosure.

FIG. **7** shows a fourth tissue repair assembly **300** of the present disclosure. The assembly **300** includes an interference device **301** having a tapered body **301***a* with threads **301***e* and a cannulation **301***b*. The assembly **300** also includes a fixation device **302** disposed within the cannulation **301***b* of the interference device **301**. The fixation device **302** includes a proximal end **302***a*, a pointed distal end **302***b*, and a channel **302***c* extending a partial length of the fixation device **302**.

FIG. **8** shows the assembly **300** being advanced into a bone tunnel **401**, such as a tibial tunnel of a knee joint. A delivery device (not shown) is inserted into the channel **302***c* and the delivery device (not shown) is used to insert a soft tissue graft **500** into the bone tunnel **401**. The soft tissue graft **500** rests on the pointed distal end **302***b* with each end **500***a*,**500***b* of the graft **500** draped over the interference device **301**. The assembly **300** and graft **500** are advanced into the bone tunnel **401**, via the delivery device (not shown) and the pointed distal end **302***b* extends through the graft **500** and into bone **402**. The threads **301***e* allow for compression of the graft **500** against the walls of the bone tunnel **401**.

Alternatively, the graft **500** is inserted into the tunnel **401**, the fixation device **302** is inserted into the tunnel **401** such that the pointed distal end **302***b* engages the graft, possibly being inserted through the graft **500** and into the bone **402**, and then the interference device **301** is inserted into the tunnel **401** such that the fixation device **302** is housed within the cannulation **301***b* and the ends **500***a*,**500***b* of the graft **500** are draped over the device **301**. Insertion of the interference device **301** into the tunnel **401** directly after inserting the tissue **500** into the tunnel **401** and subsequently inserting the fixation device **302** into the cannulation **301***b* such that the pointed end **302***b* is inserted through the graft **500** and possibly into the bone **402**, is also within the scope of the disclosure. The fixation device **302** may be of a variety of lengths and may include surface features that mate with surface features located within the cannulation **301***b* to further couple the fixation device **302** to the interference device **301**. The surface features may include threads, barbs, ribs, or other surface features known to one of skill in the art and that have the ability to further facilitate coupling between the fixation device **302** and the interference device **301**. It is also within the scope of this disclosure for the fixation device **302** and/or the interference device **301** to be made out of a material, such as a shape memory material, that expands or otherwise allows for further coupling between the devices **301**,**302** in response to body temperature or an external energy source.

FIG. **9**A shows a fifth tissue repair assembly **600** of the present disclosure. The assembly **600** includes an interference device **601** having a tapered body **601***a* with threads **601***e* and a cannulation **601***b*. The assembly **600** also includes a fixation device **602** disposed within the cannulation **601***b* of the interference device **601**. As shown in FIG. **9**B, the fixation device **602** includes a first leg **602***a*, a second leg **602***b*, and a groove **602***c* located between the legs **602***a*,**602***b*. The device **602** also includes a top portion **604** extending from the base portion **603**. As can be seen in FIG. **9**A, the top portion **604** has a smaller diameter than the cannulation **601***b* so as to allow the top portion **604** to be disposed within the cannulation **601***b*. In addition, the device **602** is cannulated to allow passage of a guide wire **610** through both the interference device **601** and the fixation device **602**. As will be further described below, the legs **602***a*,**602***b* and the groove **602***c* cooperate to house soft tissue within the groove and fixate the tissue within a bone tunnel. For the purposes of FIGS. **9**A and **9**B, the fixation device **902** is U-shaped. However, the device may be V-shaped or have any other shape known to one of skill in the art.

FIG. **10** shows the assembly **600** located on the guide wire **610**. The guide wire **610** is advanced into a bone tunnel **701**, such as a tibial tunnel of a knee joint, and the assembly **600** is disposed on the guide wire **610**, such that the guide wire **610** is passed through both the interference device **601** and the fixation device **602**. A soft tissue graft **800** rests between the legs **602***a*,**602***b* with each end **800***a*,**800***b* of the graft **800** draped over the interference device **601**. The assembly **600** and graft **800** are advanced into the bone tunnel **701** together, via a delivery device (not shown). The threads **601***e* allow for compression of the graft **800** against the walls of the bone

tunnel **701**. Alternatively, the assembly **600** may be advanced into the tunnel **701** such that the fixation device **602** is advanced into the tunnel **701** followed by advancement of the interference device **601**. In this manner, tension may be applied to the soft tissue **800** prior to inserting the interference device **601** into the tunnel **701**.

FIGS. **11** and **12** show tissue repair assemblies **900** that are similar to the fourth tissue repair assembly **300** and method shown in FIGS. **7** and **8**, albeit including a sleeve of braided or woven material **1100** on the tissue **1000**. As shown in FIGS. **11** and **12**, one strand or multiple strands of tissue **1000** may be fixated within the tunnel **1200**. While the sleeve **1100** is located between the ends **1000***a*,**1000***b*, it is within the scope of this disclosure for the sleeve **1100** to be located anywhere along the length(s) of the strand(s) **1000** or over the entire strand(s) **1000** prior to placing the tissue(s) **1000** within the bone tunnel **1200**. Having the sleeve **1100** on the tissue(s), such as in FIGS. **11** and **12**, allows for maintaining the soft tissue(s) **1000** at the tapered end **902** of the interference device **901** via insertion of the fixation device **903** through at least a portion of the sleeve **1100**, thereby alleviating the need for the fixation device **903** to be inserted through the soft tissue **1000**. However, as shown in FIGS. **11** and **12**, it is also within the scope of this disclosure for the fixation device **903** to be inserted through the soft tissue **1000** and the sleeve **1100** or the soft tissue **1000**, the sleeve **1100**, and the bone **1201**. Additionally, rather than using one sleeve **1100** for all of the strands of tissue **1000**, as shown in FIG. **12**, it is also within the scope of this disclosure to have a sleeve **1100** located on each strand of tissue **1000**. A flexible member, such as a suture, may be used to couple the sleeve **1100** to the tissue **1000**.

FIG. **13**A shows a sixth tissue repair assembly **1300** of the present disclosure that is similar to the fourth tissue repair assembly **300** of FIG. **7**. However, assembly **1300** includes a collar **1303** located on the fixation device **1302**. When the assembly **1300** is used to fixate soft tissue to bone via a method similar to the method of FIG. **8**, the collar **1303** further facilitates maintenance of the location of the soft tissue in front of, or at the tapered end of the interference device **1301**.

FIG. **13**B shows an alternative fixation device **1302** for use with repair assembly **1300**. Rather than having one pointed distal end **1302***b*, the device may have multiple pointed distal ends **1302***b*. This would allow the device **1300** to capture more of the tissue and therefore provide for increased fixation of the tissue to bone. For the purposes of FIG. **13**B, the device **1300** includes only two pointed distal ends **1302***b*. However, it is within the scope of this disclosure for the device **1300** to include more than two pointed distal ends **1302***b*.

FIG. **14** shows a seventh tissue repair assembly **1400** of the present disclosure that is similar to the tissue repair assembly **10** of FIG. **1**. However, instead of shaft **12***c*, the fixation device **1600** includes a coupling portion **1600***a* having at least two legs **1600***b*. Each leg **1600***b* has one end **1600***c* coupled to the capturing portion **1600***d* and another end **1600***e* coupled to a thread **1501** of the interference device **1500**. For the purposes of this disclosure, each end **1600***e* includes a foot **1600***f* that allows for snap lock coupling of the foot **1600***f* to the thread **1501** and therefore coupling of the fixation device **1600** to the interference device **1500**. The legs **1600***b* are tapered to accommodate the tapered end portion **1502** of the device **1500**. It is within the scope of this disclosure for the legs **1600***b* to be of different lengths such that one foot **1600***f* is coupled to one thread **1501** and the other foot **1600***f* is coupled to a different thread **1501**. It is also within the scope of this disclosure for the coupling portion **1600***a* to have more than two legs **1600***b*. The capturing portion **1600***d* is of a semi-circular shape so as to capture soft tissue in a manner similar to how the capturing portion **12***b* of the assembly **10** of FIGS. **1** and **2** capture tissue. However, the capturing portion **1600***d* may be of any other shape that would allow capturing of the tissue and maintenance of it in front of or at the tapered end **1502** of the interference device **1500** during and after repair. The ends **1600***c*,**1600***e* may be coupled to the capturing portion **1600***d* and the interference device **1500** in any manner known to one of skill in the art.

FIG. **15** shows an eighth tissue repair assembly **1700** of the present disclosure. The assembly **1700** is similar to assembly **80** of FIG. **5**. However, the interference device **1701** of assembly **1700** includes a tip **1703** that extends beyond the tapered end **1702** of the device **1701**. The fixation device **1704** is coupled to the interference device **1701** such that the tip **1703** extends through a center opening **1705** of the device **1704**. During repair, soft tissue is disposed on the fixation device **1704** in a manner similar to how soft tissue is disposed on the fixation device **82** of assembly **80** and shown in FIG. **6**.

The assemblies **10**, **40**, **80**, **300**, **600**, **900**, **1300**, **1400**, **1700** of the present disclosure, and especially the fixation devices **12**, **42**, **82**, **302**, **602**, **903**, **1302**, **1600**, **1704** maintain the location of the soft tissue in front of, or at the tapered end of the interference device **11**, **41**, **81**, **301**, **601**, **901**, **1301**, **1500**, **1701** thereby preventing slippage of the tissue past the device **11**, **41**, **81**, **301**, **601**, **901**, **1301**, **1500**, **1701** during and after repair. This substantially reduces the possibility of a failed fixation of the tissue to the bone, thereby leading to an unsuccessful repair.

For the purposes of this disclosure, the fixation devices and the interference devices are made from a resorbable polymer material. However, a metal material and other non-metal materials, either resorbable or non-resorbable, are also within the scope of this disclosure. In addition, the devices may be made via a molding process or other process known to one of skill in the art. The cannulations and channel may be formed during the molding process or after the molding process by drilling. Furthermore, rather than containing threads, the outer surface of the interference device may include other surface features that would allow engagement of the interference device with the bone tunnel and soft tissue. The threads allow for rotary advancement of the assembly and the soft tissue graft into the tunnel. However, these other surface features may allow for other advancement, such as axial advancement, into the tunnel. Also, the number of surface features may vary.

In addition, the fixation devices may be coupled to the interference devices in manners other than those described above. For the purposes of this disclosure, the method and devices, described above, are used in arthroscopic knee repair. However, the method and devices may be used in the repair of other soft tissue. The fixation devices may be of a variety of lengths and may include surface features that mate with surface features located within the cannulations to further couple the fixation devices to the interference devices. The surface features may include threads, barbs, ribs, or other surface features known to one of skill in the art and that have the ability to further facilitate coupling between the fixation devices and the interference devices. It is also within the scope of this disclosure for the fixation devices and/or the interference devices to be made out of a material, such as a shape memory material, that expands or otherwise allows for further coupling between the devices in response to body temperature or an external energy source.

Furthermore, it is within the scope of FIGS. **1**, **3**, and **14** for the fixation devices **12**,**42**,**1600** to be coupled to the interfer-

ence devices **11**,**41**,**1500** via the use of a hole on the fixation devices **12**,**42**,**1600** that at least the tapered ends **11***d*,**41***d*, **1502** are disposed within, rather than using the shafts **12***c*, **42***c*, couplers **12***d*,**42***d*, and legs **1600***b*. Additionally, it is within the scope of FIGS. **1**, **3**, **5**, and **14** for the fixation devices **12**, **42**, **82**, **1600** to be coupled to the interference devices **11**, **41**, **81**, **1500** via the use of a shaft that would extend from the coupling portions **12***a*, **42***a*, **82***a*, **1600***a* to be housed within the cannulations **11***b*, **41***b*, **81***b* of the interference devices **11**, **41**, **81**, **1500**.

Additionally, it is within the scope of this disclosure for the top portion **604** of fixation device **602** and fixation devices **903**,**1302** to have a length that extends either an entire length or a partial length of the interference devices **301**,**601**,**901**, **1301**.

As various modifications could be made to the exemplary embodiments, as described above with reference to the corresponding illustrations, without departing from the scope of the disclosure, it is intended that all matter contained in the foregoing description and shown in the accompanying drawings shall be interpreted as illustrative rather than limiting. Thus, the breadth and scope of the present disclosure should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims appended hereto and their equivalents.

What is claimed is:

1. A system for tissue repair comprising:

a fixation device comprising a base portion including a first leg, a second leg, and a groove located between the first and second legs; and

a top portion extending from the base portion;

a threaded interference device including a cannulation along its length, the cannulation including a uniform diameter; and

a delivery device to which the fixation device and threaded interference device are coupled.

2. The fixation device of claim **1** wherein both the first leg and the second leg include a pointed end portion.

3. A tissue repair assembly comprising:

a fixation device comprising a base portion including a first leg, a second leg, and a groove located between the first and second legs, and a top portion extending from the base portion; and

a threaded interference device coupled to the fixation device, wherein the top portion of the fixation device is configured for housing within a cannulation of the interference device, the cannulation including a uniform diameter along its length.

4. The tissue repair assembly of claim **3** wherein the interference device is configured for rotary advancement into a target tissue.

5. A method of tissue repair comprising:

preparing a hole in a bone;

inserting a soft tissue into the hole via the use of a fixation device; and

inserting a rigid interference device into the hole, the interference device including threads on an outer surface and a uniform cannulation along its length.

6. The method of claim **5** wherein the fixation device comprises a base portion including a first leg, a second leg, and a groove located between the legs, and a top portion extending from the base portion.

7. The method of claim **6** wherein the soft tissue is located within the groove of the fixation device when the soft tissue is advanced into the hole.

8. The method of claim **5** further comprising applying tension to the soft tissue prior to inserting the interference device into the hole.

9. The method of claim **5** wherein inserting the interference device into the hole fixates the soft tissue to the bone.

10. The method of claim **5** wherein the interference device is configured for rotary advancement into the hole.

11. The method of claim **5** wherein insertion of the interference device into the hole occurs via rotary advancement of the interference device into the hole.

12. A method of tissue repair comprising:

preparing a hole in a bone;

inserting a soft tissue into the hole via the use of a fixation device; and

inserting a rigid interference device into the hole, wherein the interference device includes a cannulation having a uniform diameter along its length and is configured for rotary advancement into the hole.

13. A method of tissue repair comprising:

preparing a hole in a bone;

inserting a soft tissue into the hole via the use of a fixation device; and

inserting a rigid interference device into the hole, wherein insertion of the interference device into the hole occurs via rotary advancement of the interference device into the hole, the interference device including a cannulation along its length, the cannulation having a uniform diameter.

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